enormous influence upon the welfare of the country and in encouraging that fecundity in invention which has always distinguished this country. His spirit, his learning and his logical mind are exhibited in 'Studien in der Praxis des k. Patentamtes,' 1890.

Hartig was named as 'kgl. sächsischen Regierungsrat,' in 1876, and as 'Geheimen Regierungsrat,' in 1888. He was decorated with the 'sächsischen Albrechtsorden Komthur 2 kl.,' and the 'sächsischen Verdienstorden Ritterkreuz I. kl.,' the 'preussische Rote Adlerorden 3 kl.' and the 'österreichische Franz Josef-Orden Ritterkreuz' and was made a member of many learned societies.

Ernst Hartig was one of the most modest and companionable of men, kindly, considerate, seeking to please his friends, and always most courteous to strangers. As a colleague on the International Jury of 1873, the writer, working side by side with him for weeks together, came to know the man and to recognize his admirable personal qualities most fully. His affection for his older colleagues and his former teachers, his friends and his pupils was always in evidence. His mind was a storehouse of information and his sincerity and quiet dignity gave him an aspect of age which was yet contra-indicated by his alert and youthful movement. He will always be remembered by those who have known him as one of the most admirable of men, the best of friends and the most able and useful of workers in a field in which there is never likely to be a surplus of such men.

R. H. THURSTON.

SCIENTIFIC BOOKS.

The Grammar of Science. By KARL PEARSON, M.A., F.R.S. Second edition revised and enlarged. London, Adam & Charles Black. 1900. Pp. 548.

It is possible to acquire a speaking and indeed a fairly extensive knowledge of a language without any special attention to its grammatical peculiarities. The conscious realization of syntax and conjugation, or of rules and exceptions may be quite unnecessary in 'picking up' an acquaintance with a new tongue in its local habitat. None the less the student even of 'French at a glance,' or of 'Fourteen weeks in German,' finds it profitable to include genders and declensions, and principles of structure in his aperçu. The more earnest student and, most of all, the specialist must penetrate still more deeply into the intricacies of grammatical structure and development. The same is true, though more readily overlooked in regard to the language of science. In both cases a facility of comprehension and expression, and a sympathy with the pervading spirit or genius of the language are of inestimable value, and for many purposes are indefinitely more useful than knowledge—particularly than unassimilated and uninterpreted book knowledge—of the results of analytical acumen. A scientifically-minded person may be more at home in the realm of scientific fact, may be less likely to wander astray, than he who has greater knowledge of principles with less insight into their practical combination. The observant but empirical linguist may interpret usage with greater success than the formal philologist. None the less the grammatical principles of science are of inestimable importance in imparting breadth and scope as well as depth of insight and vigor of logic to the conceptions of professional scientists and of that larger class who think scientifically and find an interest in scientific problems. That Professor Pearson's 'Grammar of Science' has met the needs of such thinkers creditably and suggestively, is evidenced by the appearance of the second edition, as well as by the comments of approval which greeted the first issue of the volume.

It will hardly be necessary in the notice of this second edition to present an account of the several chapters and of the method of treatment of the book; it will suffice to outline the scope and power of the whole. Three general groups of topics are included. The first portrays the general scope and spirit of science, or describes the purpose of the worker; the second interprets its fundamental conceptions, or de-

scribes the tools of the trade; the third outlines and comments upon the content of the sciences, or describes the materials to be worked upon. Science "claims that the whole range of phenomena, mental as well as physical—the entire universe is its field. It asserts that the scientific method is the sole gateway to the whole region of knowledge." The scientist is characterized by a logical attitude, by a manner of dealing with reality, which when carefully controlled leads to truth, to a common and verifiable possession of mankind. Science discourages short cuts to knowledge and immortality. Science admits and emphasizes its limitations; in an ultimate sense it does not explain but only describes; it has no relations with the supersensuous and is most suspicious of the metaphysical. Science justifies its place in human evolution by the efficient mental training it provides,* by the light it brings to bear on many problems of society;† by its practical benefits in extending control over natural resources and in increasing human comfort; by the permanent gratification it yields to the intellectual and æsthetical impulses.‡

Next we must recognize that all knowledge is a reaction of our mental functions to the stimuli of the environment. There is an essential intervening psychological process between knowledge and reality. We 'construct' our universe, and 'two normal perceptive faculties construct practically the same universe,' and thus render the results of thinking valid. A law of nature is "a *résumé* in mental shorthand, which replaces for us a lengthy description of the sequences among our sense-impressions. Law in the scientific sense * * * owes its existence to the creative power of his [man's] intellect." "It economizes thought by stating in conceptual shorthand that routine of our perceptions which forms for us the universe of gravitating matter." With a just comprehension of the fact that conceptual results form an essential portion of the equipment of science, which is by no means limited to perceptual sense-experience, we may proceed to develop the most profitable conceptions of those general relations underlying the problems of the special sciences. What are cause and effect, and probability? What is the scientific interpretation of space and time, of motion and matter and of their combinations in the physical and organic worlds? With these tools well sharpened and adjusted to their materials the scientific artisans may be sent to their several workshops to work with what success they can command; they devote themselves to physics and chemistry and mechanics; and they find the most distinctly different material in the realm of biology and in the several phenomena of life and evolution. And it is because the sciences are not ready-made material but represent the variety of human interest and the conceptual reactions to perceptual experience that their attempted classification has yielded so diverse and on the whole so unsatisfactory results.

Such, in brief, is the progress of thought in Professor Pearson's 'Grammar.' Many will differ with him in one and another of his positions. The metaphysician will be quick to point out that Professor Pearson's horror of metaphysics is itself the product of a metaphysical assumption; and if the more easy-going scientist expresses his belief that all these matters, like æsthetic judgments, are matters of taste, the logical reply is not far to seek. They are matters of taste, of good taste and bad taste; of sound and critical analysis or of slipshod and loose assumptions. "To know requires exertion, and it is intellectually easiest

* "It is the want of impersonal judgment, of scientific method, and of accurate insight into facts, a want largely due to a non-scientific training, which renders clear thinking so rare, and random and irresponsible judgment so common in the mass of our citizens today." "Scientific thought is not an accompaniment or condition of human progress, but human progress itself." (Clifford.)

† "Strange as it may seem, the laboratory experiments of a biologist may have greater weight than all the theories of the state from Plato to Hegel!" "The first demand of the state upon the individual is not for self-sacrifice, but for self-development." "The formation of a moral judgment * * * depends in the first place on knowledge and method."

‡ "If I were compelled to name the Englishmen who during our generation have had the widest imaginations and exercised them most beneficially, I think I should put the novelists and poets on one side and say Michael Faraday and Charles Darwin."

to shirk effort altogether by accepting phrases which cloak the unknown in the undefinable.'' Others again may object to the particular make-up of this 'Grammar'; may question whether the long discussion of the quantitative aspects of evolution (a novel feature of the second edition) however interesting in itself, finds a co-ordinate place with the rest of the chapters, or whether it represents unduly the special trend of the writer's interests. But no critic can fail to find the general treatment rigorous and suggestive, and to feel that the possibilities of presenting the fundamental conceptions of science to the student have been appreciably increased by Professor Pearson's labors in his behalf. JOSEPH JASTROW.

The Microscopy of Drinking Water. By GEORGE CHANDLER WHIPPLE. New York, John Wiley & Sons. 1899. Pp. xii + 300. With 21 figures and 19 half-tone plates.

The biological examination of potable water has been conducted upon an extensive scale in this country for more than a decade, especially in Massachusetts where the State Board of Health and the City of Boston have maintained laboratories for the scientific investigation of water supplies. It is fitting, therefore, that the first extensive hand-book upon the subject of the microscopy of drinking water should have been written by one long associated with this work.

Mr. Whipple's 'Microscopy of Drinking Water,' is more, however, than a mere manual, for it presents the generalization derived from the explorations and statistical data accumulated by the State Board of Health, the Boston, and more recently the Brooklyn Water Works for a series of years. It thus treats of many problems of limnology and fresh water biology of interest not only to the sanitary engineer and water expert but to the biologist and physicist as well.

The opening chapter is devoted to a historical treatment of the subject in which the faunistic and systematic biology of fresh water, and planktology also, are included. The treatment is brief and there are many omissions. There is, for example, no mention of recent investigations of water supplies in European cities, nor is any reference made to the lacustrine explorations of the United States Fish Commission in past years. The excellent work of the Bohemian Survey and of the Balaton Lake Commission in Hungary is unnoticed. Hensen, the father of planktology, is referred to as having devised a 'new method of studying the minute floating organisms found in *lakes!*' The planktonocrit is ascribed to Dolley, and the Plankton pump to Ward and Fordyce. The first use of the centrifuge in plankton work seems to have been made by Krämer or Cori, and the pump for the collection of plankton was used by Henson, by Peck, at the Illinois Biological Station, and by Frenzel, before the pump named was described.

Bacterial examination is not treated in the work as its methods are different and involve other processes than microscopical examination. The purpose and relative values of the various forms of sanitary examination are discussed at length by the author. The physical, biological and chemical analysis of water supplies are each important, and are mutually supplementary. The interpretation of an analysis is a matter of expert skill quite as much as the making of the analysis. "In the detection of pollution the chemical and bacteriological examinations furnish the most information, in the study of the æsthetic qualities of a water the physical and microscopical examinations are most important, while in investigations concerning the value of a water for industrial purposes the physical and chemical examinations sometimes suffice.'' The purposes of microscopical examination are stated to be the detection of sewage pollution, the explanation of turbidity, of taste and of odor of water, the interpretation of chemical analysis, and the study of food of fishes and other aquatic animals. The most important service which the microscopical examination of potable water renders is thus in the study of its æsthetic qualities.

The Sedgwick-Rafter method of water examination is described with its various modifications and improvements, and the errors incident to its use are discussed. The error from leakage through the sand may rise as high as 25 per cent. or even 50 per cent. when minute organisms are present in large numbers, and the statement is made that most of the escaping organisms pass through the sand in the